DOCUMENT RESUME

ED 058 271 TM 000 981

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TITLE A Movement-Matrix Technique for Determining Strata of Pre- and Post Change of Individual Subjects.
INSTITUTION Detroit Public Schools, Mich. Dept. of Research and Development.
PUB DATE [71]
NOTE 8p.

EDRS PRICE MF-$0.65 HC-$3.29
DESCRIPTORS Cognitive Measurement; *Comparative Statistics; Information Dissemination; *Measurement Techniques; *Post Testing; *Pretesting; Research Tools; *Statistical Analysis; Statistical Studies; Statistics

ABSTRACT

Conventional methods used for the presentation of pre- and post statistical information generally are deficient in economy and compactness and fail to show internal movement from pre- to posttest. This technique precludes these shortcomings through the presentation of information in a highly visible manner which reveals the strata of internal change. It is closely related to the contingency-table approach but adds the missing bit of information -- what happened to the individual subject's scores between the pretest and posttest. Furthermore, the procedure will accept only individuals for whom there are both pre- and post measures. The method may be employed with cognitive or non-cognitive data and is equally adaptable to parametric or non-parametric measures. (Author/DLG)

A Movement-Matrix Technique for Determining Strata of Pre- and Post Change of Individual Subjects

by

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Abstract

Conventional methods used for the presentation of pre- and post statistical information generally are deficient in economy and compactness and fail to show internal movement from pre- to posttest.

The technique presented is intended to preclude these shortcomings through the presentation of information in an expedient and highly visible manner which reveals the strata of internal change. It is closely related to the contingency-table approach but adds the missing bit of information -- what happened to the individual subject's scores between the pretest and posttest. Furthermore, the procedure will accept only individuals concerning whom there are both pre- and post measures.

The method may be employed with cognitive or non-cognitive data and is equally adaptable to parametric or non-parametric measures.

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A Movement-Matrix Technique for Determining Strata of Pre- and Post Change of Individual Subjects

This article is intended to describe a technique for the presentation of pre- and post statistical information which bears the qualities of economy and compactness and is generally more internally informative than conventional methods used in the treatment of such information.

The method possesses a utilitarian characteristic which permits its employment with either cognitive or non-cognitive data and is equally adaptable to parametric or non-parametric measures. It allows the presentation of information in an expedient and highly visible manner, and it reveals the strata of internal change, a capability usually precluded by the limitations of measures of central tendency. A brief review of some of these limitations may be useful at this point.

A simple and common technique used to test whether any change has occurred between the administration of a pretest measure and a posttest measure is to compare the arithmetic means computed for the two measures. This minimal information about the two groups of measures is usually augmented by including the standard deviation of each group. This comparison can be further dignified by calculating the c statistic to test the significance of any difference in means between the two groups.

Comparisons based on these statistics can lead to some possibly peculiar conclusions. If the two score distributions were approximately normal, the relative positions of the scores for each individual could be reversed between the pretest and the posttest. The highest scoring individual on the pretest could have the lowest score on the posttest, the second highest scorer on the

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pretest could have the second lowest score on the posttest, and so on. In the absence of any correlation measure between the pre- and posttest scores, the three aforementioned statistics would report that there was no difference between the groups.

Another approach to comparing pretest results with posttest results involves either the stratification of the data or the use of contingency tables. These procedures may be used with test score intervals or with discrete data such as pupil attendance or tardiness to school. They have the advantage of showing not only a range of values for the variable under study but also any characteristic of the way in which the variables are distributed.

The contingency-table approach, however, suffers from the same criticism leveled at the statistics mentioned above. They describe the numbers of individuals scoring at a particular level on both the pretest and the posttest, but they do not tell whether they are the same individuals or different individuals who are occupying that particular pre-post stratum. More succinctly, they do not show internal movement from pre- to posttest. Again, either parametric or non-parametric tests of significance applied to tables such as these can lead to misleading results.

The movement-matrix procedure described in this article is closely related to the contingency tables but adds the missing bit of information -- what happened to the individual subject's scores between the pretest and the posttest. Furthermore, it will accept only individuals concerning whom there are both pre- and post measures.

An effort to determine significant differences in the pre- and post academic grades of school children who have been exposed to an intervening variable may serve to illustrate the method. One may wish to learn, for example, whether the inclusion of a reading-improvement course in the program of a random group of 140 junior high school students would have a significant effect on their

social studies course marks over a period of a school year.

Assuming that the traditional grades of A, B, C, D, and E are employed by their teachers for evaluatory purposes, a 5 x 5 fold working table is constructed for the dual purpose or recording simultaneously each student's grade immediately preceding and following his reading course experience.

The horizontal cells (columns) from left to right represent the pre-program marks in which the cells at the left extremity of the fold are used to record the E's and those at the opposite extremity are employed to record the A's. Similarly, the vertical cells (rows) from the bottom to top of the fold are used to record the post-program marks. It is noted that the pre- and post academic grades for each youngster are posted simultaneously on the matrix table in horizontal-vertical sequence and are represented by a single dot symbol.

For example, a child whose mark, both pre- and post, was a "C" would be represented by a dot in the very center cell of the fold. Another youngster whose pre-program mark was an "E" but whose post-program mark was an "A" would be represented by a dot in the upper-left corner cell. Thus, the posting of the pre-post marks of pupils in the upper-left off-diagonal cells indicates degrees of improvement. Conversely, posting in the lower-right off-diagonal cells of the fold is indicative of retrogression. The posting in the cells which comprise the diagonal from the lower left to the upper right corner represent those for whom no mark change had occurred.

A hypothetical distribution of the pre-post marks of the students cited above is depicted in Diagram 1 which comprises a typical tally sheet. The geographical location of the dot symbols, as noted above, reveals what has happened to each student with regard to his pre and post-program evaluatory grades.

DIAGRAM 1

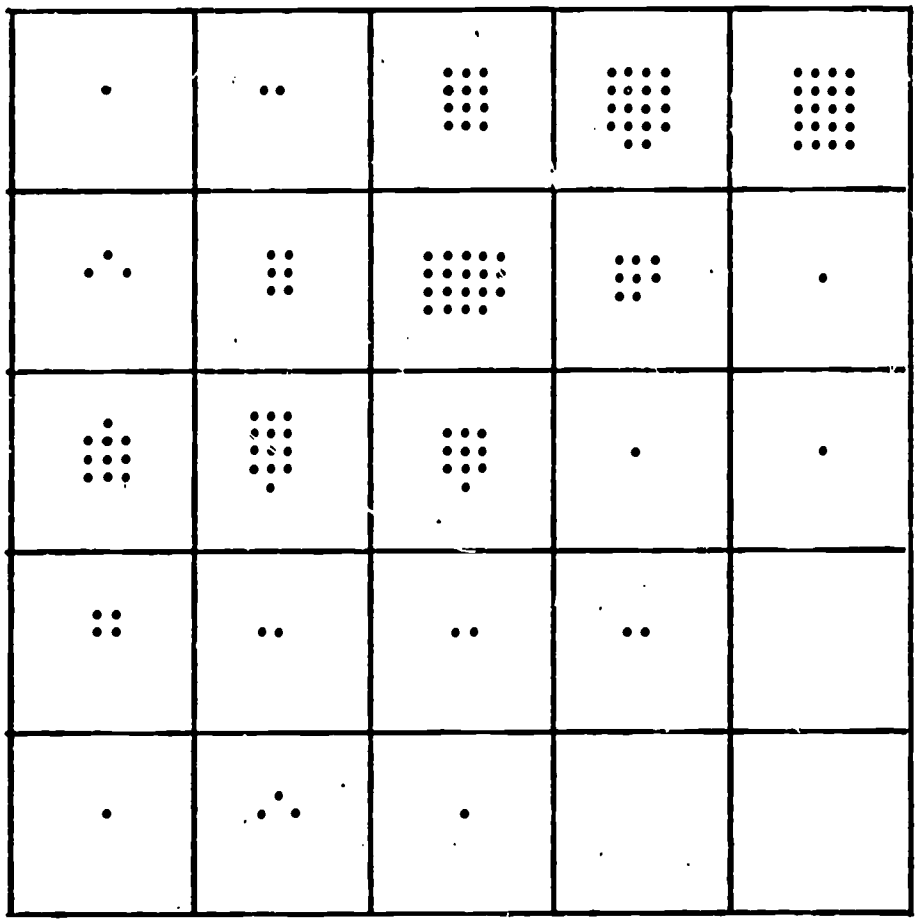

DIAGRAM 2

Totals	19	26	44	29	22	
53	1	2	12	18	20	A
37	3	6	19	8	1	B
35	10	13	10	1	1	C
10	4	2	2	2	0	D
5	1	3	1	0	0	E
	E	D	C	B	A	

Post-Program Marks

Pre-Program Marks

$X^2 = 29.21$, significant at the .01 level.

Note: Numerals in red are to italicized.

A tally of the dots in each of the 25 cells is represented by the numerical entries in Diagram 2.[1] For purposes of interpretation the numerals above the broken lines are representative of the number of pupils who manifested a pre-post improvement of at least two marks (for example, a "D" to a "B"), whereas those numerals below the broken lines are indicative of numbers of pupils who retrogressed by a similar margin. The diagonal numerals (italicized) from bottom left to upper right depict the numbers of youngsters whose pre- and post grades were respectively identical and, therefore, showed no change.

The data show that eighty-eight (63%) students improved by at least one mark on a pre-post basis, and that eleven (8%) students retrogressed by one mark or more. The evaluatory grades of forty-one (29%) youths remained at identical pre-post levels. On the basis of a change of two marks or more, it is seen that thirty-four (24%) pupils progressed by this extent, and four (3%) pupils showed corresponding retrogression.[2]

A unique quality of the movement-matrix technique lies in its capacity to reveal the changes which occurred in the pre-post marks (or test scores, self concepts, etc.) of each individual in the group under study. It is seen that nineteen (14%) students improved their mark from a "C" to a "B", and that twelve (9%) youths improved by two grades, having progressed from a "C" to an "A" grade. Conversely, it is shown that two youths who had merited a grade of "A" prior to the reading-improvement variable retrogressed to marks of "B" and "C" respectively. Moreover, ten individuals (center cell) who had been "C" students prior to the program were accorded an identical grade at the program's conclusion.

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[1]For pragmatic implementation, the tally sheet alone may be used for all computational procedures.

[2]The marginal totals of the pre-program columns and their counterpart post-program rows are adaptable to the chi square test of statistical significance. In this instance the differences were significant at the .01 level.

The extent of improvement or retrogression, if any, in the pre- and post marks of each student comprising the sample may be ascertained by this technique, and it also discloses collective information regarding the group as a whole or portions thereof. Data concerning sub-groupings according to sex, age, I.Q., etc., may be similarly depicted.

In addition to its employment with discrete data as in the example described, the method is likewise adaptable to usage with scaling measures. Limited only by feasible considerations of the numbers of intervals one wishes to employ for a given purpose, it is believed that the movement-matrix method of determining pre- and post changes among individual subjects, as well as by the composite group, will prove useful to those who regard such information pertinent to their goals and purposes.